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(54) **An alternative current generator with a voltage regulator unit for use in vehicles.**

(57) An alternate current generator having a housing consisting of directly coupled frame pieces (1,1') and a stator core (3a) fixed directly to the inside surface of one of said frame pieces and a pair of fans (8,8') fixed to the side surfaces of the pole cores (6,6') of the rotor, mainly in order to increase the structural strength and the cooling efficiency of the generator.

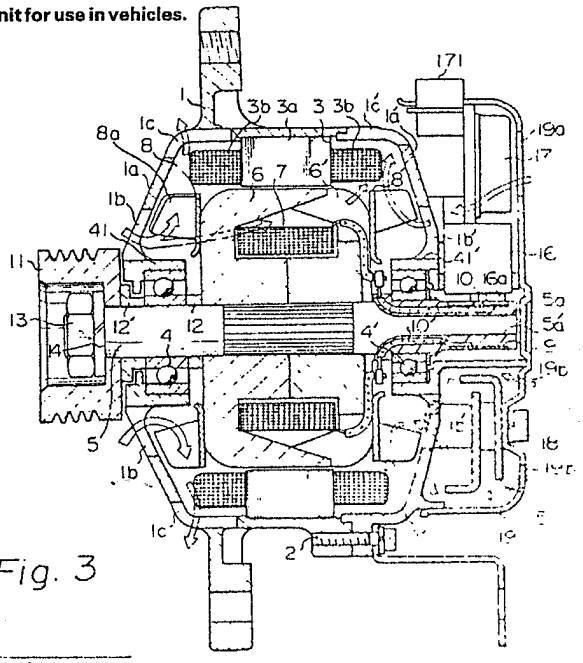


Fig. 3

EP 0 300 063 A1

An Alternate Current Generator with a Voltage Regulator Unit for Use in Vehicles

The present invention relates to an alternate current generator with a voltage regulatur unit used, for example, in vehicles.

The rotational Speed of an alternate current generator used in vehicles can be increased by using a poly V belt as the driving means. In order to realize such a high speed alternate current generator, it is necessary to make the structure of the generator firm so as to reduce flection of the axis of the generator, to reduce vibrations of the generator, to give the generator an excellent centrifugal force characteristic, and hence to make the generator competent to withstand the high speed rotation. Also, it is necessary to provide an excellent cooling system in which stator windings, rectifiers, a regulator of the integral circuit type, rotor winding and bearings can be cooled in a suitable manner. Further, it is necessary to reduce the noise of the generator when rotating, which noise arises from the friction between the blades of the cooling fan in the generator and the air.

The present invention is directed to improve the structure of the alternate current generator so as to comply with the above described requirements for the high speed rotation of the alternate current generator.

It is the main object of the invention to create a high speed alternate current generator which has increased structure strength and exerts reduced vibration.

This object is solved according to the invention with the feature of claim 1.

Fig. 1 illustrates an elevational view of the alternate current generator as an embodiment of the present invention,

Fig. 2 illustrates a side view of the alternate current generator of Fig. 1 in which the rear cover is removed, and

Fig. 3 is a cross-sectional view of the alternate current generator of Fig. 2 as an embodiment of the present invention, taken along line III-III.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The structure of the alternate current generator in accordance with an embodiment of the present invention is illustrated in Figs. 1, 2 and 3. The housing of the generator consists of a pair of frame pieces 1 and 1' which directly connect with each other at their circular edges to form an area to accomodate the operative members of the alternate current generator. The frame pieces 1 and 1' are fixed to each other by through bolts only one of which is illustrated as a through bolt 2 in Fig. 3.

The bearing boxes 41 and 41' are fixed to the inner

central portions of the frame pieces 1 and 1' and accomodate the bearings 4, 4' through which a shaft 5 is penetrated. Because the frame pieces 1 and 1' are coupled directly and firmly to each other, the precise positioning of the bearing boxes 41, 41' and the bearings 4, 4' is attained and errors in the positions of the centers of the bearings 4, 4' are minimized, and accordingly the precise support of the shaft 5 is attained. This helps the high speed rotation of the shaft 5 and reduces the vibration during the high speed rotation of the shaft 5.

The axial length of the housing formed by the frame pieces 1 and 1' decreases from the axis portion toward the circumferential portion. Accordingly, the housing has a swollen shape similar to the shape of an egg as illustrated in Fig. 3. This shape is advantageous because of the increased structural strength of the generator.

A core 3a of a stator 3 is fixed directly to the inside of the frame 1. The entire outside surface of the core 3a of the stator 3 contacts the inside surface of the frame 1. Heat generated in the stator core is conducted through said entire to the frame. This helps the efficient cooling of the stator A stator winding 3b is wound around the stator core 3a.

The rotor core fingers 6 and 6' are offset circumferentially with respect to each other, as is well known to a person skilled in the art. The pole core of the rotor is located inside of the stator 3 and is fixed to the shaft 5. A rotor winding 7 is wound around the pole core of the rotor.

Cooling fans 8 and 8' are fixed to the side surfaces of the pole cores 6 and 6' of the rotor. The diameter of each of the cooling fans 8 and 8' is smaller than the inner diameter of the stator 3. Blades of the cooling fans 8 and 8' extend in outward directions. The number of the blades 8a of the cooling fan 8 is the same as the number of the rotor core fingers 6. The number of the blades of the cooling fan 8' is determined in accordance with the flow

rate of the coolant air. The cooling fan 8 is of a mixed flow type having slant blades 8a so as to forward the coolant air to the rotor not only in the radial direction, but also in the axial direction so that the rotor core is sufficiently cooled by the coolant air (The blade 8a is slant in the direction of rotation.) The cooling fan 8' is of a centrifugal type.

The fresh coolant air is drawn through the intake windows 1b and 1b' formed adjacent to the bearing boxes 41 and 41' in the frame pieces 1 and 1'. The heated coolant air is exhausted through the exhaust windows 1c and 1c' formed adjacent to the stator 3 in the frame pieces 1 and 1'.

Slip rings 9 are connected to the rotor winding 7 through conductors 10, 10' arranged in slots 5a, 5a' in the shaft 5. The slip rings 9 are arranged on the shaft 5, adjacent to the position of the bearing 4' and outside of the frame pieces 1, 1'.

A pulley 11 having four grooves is fixed to one end of the shaft 5 by a screw nut 13 and a washer 14. Collars 12 and 12' are inserted between the rotor core 6 and the bearing 4 and between the bearing 4 and the pulley 11. The pulley 11 is driven by an engine through a poly V belt (not shown).

A diode fin 15 carrying diodes, brushes 16a supplying an excitation current to the rotor winding through the slip ring 9 and conductors 10, 10', brush holders 16, and a voltage regulator unit 17 of the hybrid integral circuit type (so-called the IC type) for controlling the field current of the generator are arranged outside of the frame pieces 1, 1' and are accomodated in a rear cover 19 which is fixed to the frame piece 1' by bolts 18. Only one of said bolts 18 is illustrated in Fig. 3. The rear cover 19 serves as a protective cover for the above described elements accomodated in the rear cover 19 outside of the frame pieces 1, 1'. Windows 19a and 19b are provided in the rear cover 19 for the cooling of the regulator 17 and

the diode fin 15. Diodes 151, 152 and 153 are located in the recesses on the diode fin 15 (Fig. 2). The heat generated in the diodes is effectively dissipated in the coolant air through the diode fin.

An electrical connector 171 is provided adjacent to the regulator 17 to form an electrical connection to a storage battery and the like. Because all of the main static electrical elements, such as diodes, brushes, brush holders, a regulator and an electrical connector are arranged compactly outside of the frame pieces 1, 1' and in the space formed by the rear cover 19, only a small length of the conductors is required for the electrical connections among the main static electrical elements.

In operation, the coolant air drawn through the window 1b cools in sequence the bearing 4 and the stator winding 3b, and the resultant heated coolant air is exhausted through the window 1c. A portion of the coolant air drawn through the window 1b is pushed into the rotor structure through the gaps between the rotor core fingers 6, 6' to cool the rotor winding 7, passes through the stator winding 3b, and is exhausted through the window 1c'.

Simultaneously with the above described cooling, the coolant air drawn through the windows 19a, 19b of the rear cover 19 cools either the regualtor 17 or the diode fin 15, and is then drawn into the housing formed by the frame pieces 1 and 1' through the windows 1b'. The coolant air drawn into the housing cools in sequence the bearing 4' and the stator winding 3b and the resultant heated coolant air is exhausted through the window 1c'.

CLAIMS

1. An alternate current generator comprising a shaft, a pole core of a rotor fixed to said shaft, a rotor winding wound around said pole cores, a stator core arranged around said rotor, a stator winding wound around said stator core and a housing encasing said rotor and said stator, characterized in that;

said housing consists of a pair of frame pieces which are coupled directly to each other at their circular edges,

a plurality of exhaust windows are formed at circumferential walls of said pair of frame pieces,

said stator core is fixed directly to one of said frame pieces, so that the outside surface of said stator core contacts the inside surface of said frame piece,

a pair of bearing boxes are arranged in the central portions of said frame pieces inside of said housing formed by said pair of frame pieces,

a pair of fans are fixed to the side surfaces of said pole cores of said rotor, at least one of said fans is of a centrifugal type,

slip rings are fixed to said shaft outside of said bearing boxes, and

the associated elements including brushes, rectifiers and a voltage regulator unit are located outside of said housing formed by said frame pieces at such a side where said fan of the centrifugal type is fixed to said side surface of said pole core of said rotor.

2. An alternate current generator as defined in Claim 1, wherein the diameter of each of said fans is smaller than the inner diameter of said stator.

3. An alternate current generator as defined in Claim 1, wherein the other fan is of a mixed flow type having a slant blades for supplying cooling air to said rotor both in the radial and the axial directions.

4. An alternate current generator as defined in Claim 1, wherein said slip rings are connected to said rotor winding through conductors arranged in slots in said shaft.

5. An alternate current generator as defined in Claim 3, wherein the number of blades of said fan of the mixed flow type is the same number of the rotor core fingers of said pole core.

3/1

Fig. 1

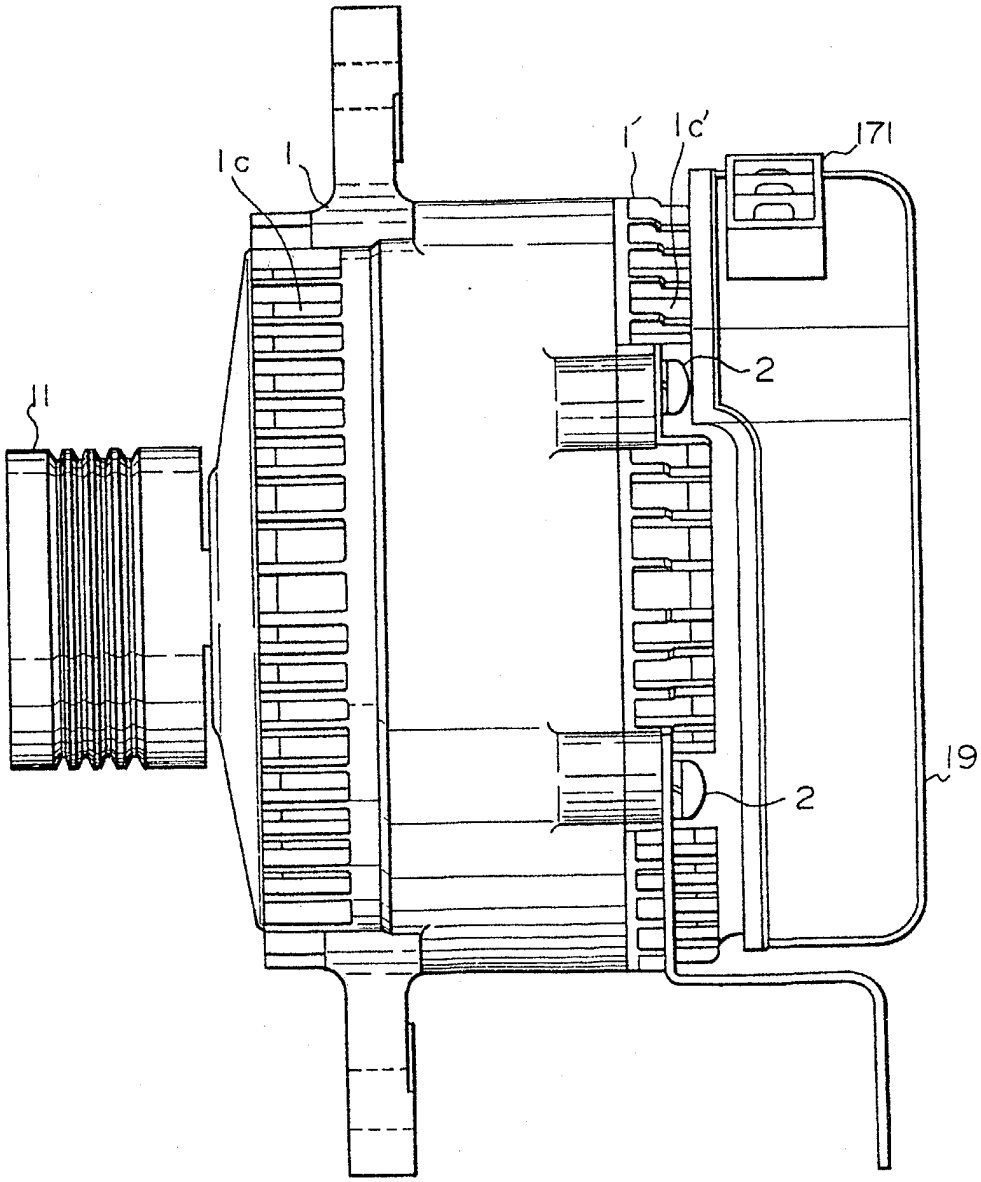
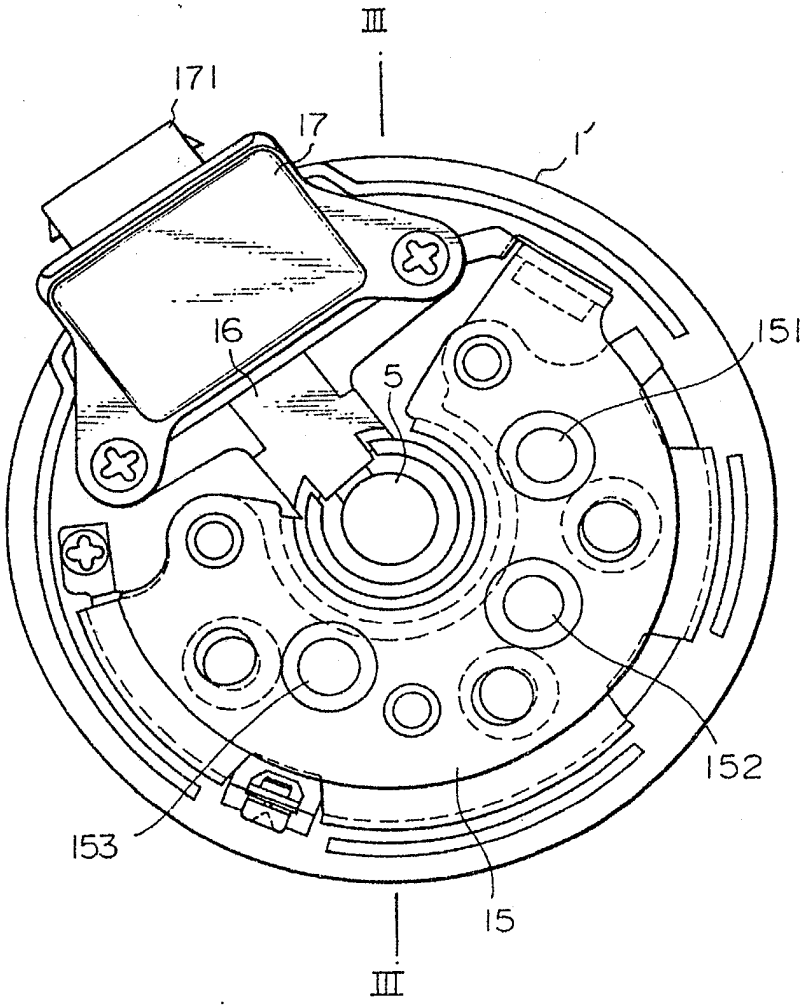


Fig. 2



3/3

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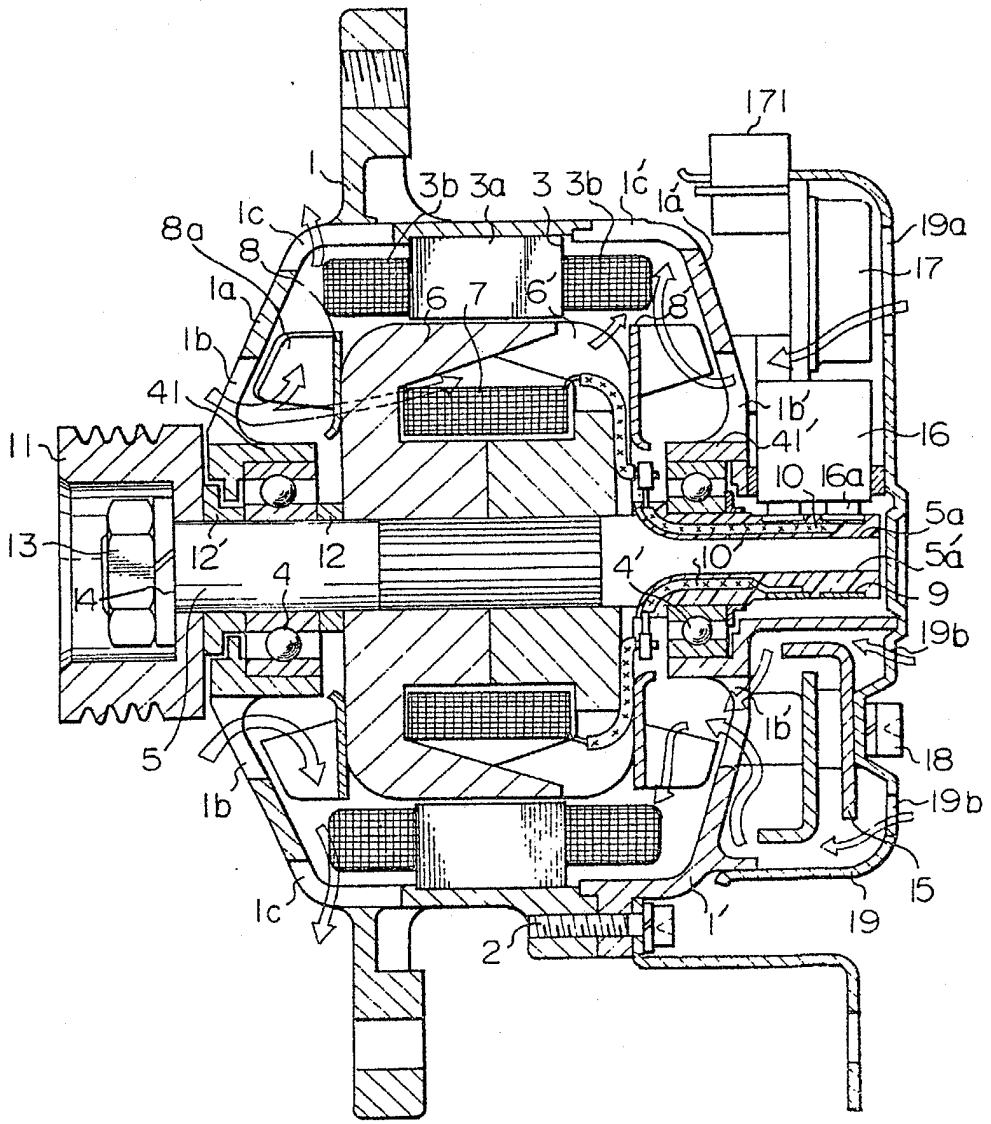
Fig. 3


171
1
3b 3a 3 3b 1c' 1a'
19a
8a
1c
8
17
1a
6 7 6'
8'
1b
41
1b'
16
11
41'
10 16a
5a
13
12' 4 12
4'
10
5a'
14
9
19b
1b'
18
5
1b
19b
15
1c
1'
19
2

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EUROPEAN SEARCH REPORT

Application number
EP 84 11 4880

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
X	US-A-3 198 972 (R.L. LARSON) * Column 1, line 63 - column 2, line 55; column 4, line 47 - column 5, line 12; figure 3 *	1-5	H 02 K 9/06 H 02 K 19/36 H 02 K 11/00
X	US-A-3 253 167 (C.E. BATES et al.) * Column 1, line 57 - column 2, line 45; column 4, line 34 and following *	1-5	
A	CH-A- 441 492 (SIEMENS) * Column 2, lines 9-34; column 4, line 14 - column 5, line 20 *		
A	DE-A-1 613 189 (LICENTIA) * Page 2, paragraph 2 and continuation, page 3 *		TECHNICAL FIELDS SEARCHED (Int Cl.4) H 02 K 9/00 H 02 K 11/00 H 02 K 19/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	23-04-1985	GESSNER E A F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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